Spring 2023

PHYS 450 - 002: Advanced Physics Lab

Hyomin Kim

PHYS 450, Spring 2023: Advanced Physics Lab

Time: Fridays. 1:00 pm - 3:50 pm
Room: 001A Tiernan Hall (lab), 403 Faculty Memorial Hall (for occasional lectures)
Office Hour: Fridays, 10:00 am-11:00 am, other times by appointment

INSTRUCTOR

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DESCRIPTION

In the advanced Physics Laboratory students will learn about physical phenomena by performing quantitative measurements of fundamental physical constants, like the gravitational constant. Students will also gain experience with experimental techniques, such as Fourier methods and Hall effect, which are common in physics laboratories in academia and industry. This course focuses on solving problems, which occur in experimental measurements and offers basics of data acquisition, data analysis, data storage, and professional data presentation. This course is mostly unstructured, in which students are given the equipment and related manuals and perform experiments without the instructor's guidance. Students are highly encouraged to plan experiments and perform necessary analyses independently.
*Prerequisites***:** PHYS 335 (Introductory Thermodynamics), PHYS 430 (Classical Mechanics I), PHYS 432 (Electromagnetism I), all with grade of C or better.

LEARNING GOALS

- Learn about physical phenomena by performing quantitative measurements
- Gain experience with techniques and instrumentation used in modern physics laboratories in academia and industry
- Gain experience in solving problems, which occur in experimental measurements
- Learn basics of data acquisition, data analysis, data storage, and data presentation

MATERIALS

A lab notebook that can be handed in for a grade

RECOMMENDED REFERENCES

For students taking 450, it is strongly recommended that you obtain a copy of:

- Strunk and White, "The Elements of Style", (MacMillan, New York, 1979)

- Bevington and Robinson, “Data Reduction and Error Analysis for the Physical Sciences”, 3rd Edition,(McGraw-Hill Education, 2002)

OUTLINE OF THE COURSE

- Students should work in pairs or triples and divide the work between them evenly. While the data will be shared, each student will write his/her own lab report. The goal of this course is to help students enhance their ability to solve experimental problems. You should try to work out problems for yourself, but the lab instructor and teaching assistant (if assigned) will be glad to make suggestions when necessary.
- Students should show up in the lab during the period assigned to them and expect to spend the full three hours working on the experiment. Students who complete the course requirement before the end of the semester are encouraged to work on additional experiments for extra credit, but only during their regular lab hours. Exceptions should be discussed with staff.
- Each student must attend the lab at the beginning of each period; report to the staff if you will be leaving to do library or computer work on that day. Occasionally there may be short lectures on computers, instrumentation, experimental techniques, etc. at the beginning of the lab class.
- A lab notebook is required for each student. You should record everything about your experiment in the lab notebook. When starting an experiment, you should write down a description of the experiment and appropriate references, plus any notes you take from references, etc. Include sample calculations and detailed sketches of experimental apparatus. Note relevant settings on instruments (e.g., amplifier gain, etc.).
- All data should be recorded directly into the lab book. Do not use scraps of paper for recording data. If the data are acquired using a computer, then a digital copy may be required to submit along with the lab report.
- Each team will do a total of THREE (3) experiments of their choice (see list of experiments). There will be a presentation of one of the experiments at the end of the semester (see the course timetable).
- Your lab reports must be submitted on or before the deadline. The experiments will be graded by the instructor.

POSSIBLE LABS

- Cavendish Experiment
- Quantum Analog Well/Quantum Analog Atom
- Fourier Methods
- Magnetic Susceptibility
- Hall Effect
- Photoelectric Effect
- OTHER: discuss with the instructor

GRADING

- Your final grade will be based on the total points obtained using the following schemes.

Lab Notebook Check:	10
Experimental Results:	10 x 3 labs
Experimental Report:	10 x 3 labs
Presentation:	30

- Lab report due is shown in the schedule (by 11:59 pm Eastern Time).
- Late lab reports will be penalized (5% each day).
- Careful experimental technique and Physical-Review-quality lab reports are necessary for a good grade.
- The grading breakdown is as follows:

85-100%	A
80-84%	B+
70-79%	B
65-69%	C+
50-64%	C
40-49%	D
Below 40%	F

GENERAL LAB RULES

- There will be no food, chewing gum, or beverages allowed in the Lab.
- If equipment seems to be malfunctioning, work with the lab instructor to address the issue.
- Lab manuals and equipment manuals may be signed-out for copying but must be returned immediately.
- Damaged or lost manuals should be reported for replacement.
- If you break something, report it immediately.
- Clean up after your lab session; leave the apparatus and work area in good condition for the next group.
- Return tools, support stands, rods, brackets, etc. to the proper place. If you don't know the proper place, ask.
- When you need a tool from a set (e.g. a set of wrenches), take the whole set, then return it whole. It is easier to locate a whole set than one missing piece.

ACADEMIC INTEGRITY

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the

university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.

Refer to the "Best Practices" document developed and published on the Provost's website (on the policies page) or directly at https://www.njit.edu/provost/sites/njit.edu.provost/files/Best_Practices_related_to_Academic_Integrity.pdf .

CLASS SCHEDULE FOR SPRING 2023

Note: Occasionally, there will be short lectures (see the schedule below) in FMH 403.

Week	Activity
Week 1 (Jan 20)	Introduction and Review of Syllabus, START LAB 1
Week 2 (Jan 27)	Lab Reports, Papers, Figures, LaTeX
Week 3 (Feb 3)	Academic Research
Week 4 (Feb 10)	LAB 1 DUE
Week 5 (Feb 17)	LAB 1 FEEDBACK SESSION
Week 6 (Feb 24)	
Week 7 (Mar 3)	
Week 8 (Mar 10)	LAB 2 DUE
Week X (Mar 17)	Spring Recess
Week 9 (Mar 24)	LAB 2 FEEDBACK SESSION, Scientific Presentations 101
Week 10 (Mar 31)	
Week 11 (Apr 7)	No Class (Good Friday)
Week X (Apr 14)	
Week 12 (Apr 21)	LAB 3 DUE
Week 13 (Apr 28)	PRESENTATIONS
Week 14 (Tuesday, May 2)	PRESENTATIONS, Friday classes at NJIT run on Tuesday (May 2) - Last day of class